

## PART #3

### Forest Health of the United States' Forests

#### WHAT IS THE PRESENT CONDITION OF OUR FORESTS?

#### INTRODUCTION

Different values are provided to various extents by each forest depending on its innate ecological characteristics, history, ownership patterns, and other factors. Although there is very much variation in conditions within each region, this discussion divides the United States into five regions (Figure 1.1)--North, South, Inland West, Pacific Coast, and Alaska<sup>1</sup>. For this report, the "Rocky Mountain" region of the<sup>1</sup> RPA is referred to as the "Inland West," as was done in Part #1.

The regions vary in their **potential** to provide each value and the extent to which they are currently **realizing** their potential. For example, the South has a **high potential** for timber volume production because of its high growth rate and large forested area, while the Inland West has a small forested area and low growth rate--and therefore **low potential** for timber production.

The South is also currently **realizing** its timber volume production potential to a high degree because it is harvesting or otherwise removing<sup>2</sup> 74 percent of its gross growth, while the Inland West currently is only slightly **realizing** its potential because it is only harvesting 29 percent of its gross growth.<sup>3,4</sup>

A low potential for a region does not imply that the value in that region is not locally or nationally important. For example, Alaska has a low potential to

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<sup>1</sup> These regions generally conform to the Resource Planning Act Assessments (e.g. Powell et al. 1993). The "Rocky Mountain" region of the RPA is referred to as the "Inland West" for this document. Eastern Washington and Oregon statistics are included in the "Pacific Coast", even though their ecological, silvicultural, and socioeconomic characteristics are more similar to the Inland West. Alaska is separated as an independent region because its large size may confuse its contribution to forest values is included within any other region.

<sup>2</sup> For definition of "removal" and other terms, see Tables C-3 and C-4.

<sup>3</sup> 91% and 38% of the "net growth" in the South and Inland West, respectively. "Gross growth" refers to the increase in "growing stock"<sup>4</sup>, including mortality (but not subtracting timber harvest). For RPA analyses, "net growth" is often used, which refers to increase in growing stock after mortality (but not timber harvest) has been subtracted. "Gross growth" is used in this assessment because the role of mortality in habitats, fire potential, and potential utilization is important; and because some forests (e.g., Southeast Alaska) may appear to be growing slowly if expressed as net growth, when they are actually growing quite fast, but are also experiencing high mortality.

<sup>4</sup> "Growing stock" refers to volume of trees meeting certain standards of quality and vigor. These usually comprise 90% or more of the total volume (Table B-3).

provide timber volume relative to other regions; however, the timber employment is a much larger segment of Alaska's local economy than it is for other regions. Any decision to concentrate values in regions of high potential can have important ramifications for the values.

Generalizing about the potential and realization of values in each region is difficult. Examination of forest statistics, however, begins to show the range of concern over the values.

Four approaches are used to provide an understanding of the conditions of the forest relative to the various values:

1. Figures and tables give basic characteristics of the forests (Appendixes B & C);
2. Detailed descriptions of the condition of each value are given in the following text;
3. Figure 1.4.1 through 1.4.6 show the relative potential and current condition of each value for the United States and each region as estimated by the Forest Health Science Panel, based on the reasoning and data described throughout this report;
4. The preceding "Summary" briefly describe the conditions.

Used together, the four approaches are intended to contribute to an understanding of the forest conditions.

## **I. VALUES EXPRESSED AS DESIRED CONDITIONS OF THE FOREST** **(TABLE 1.1A)**

### **SUSTAINING GROWTH OF FORESTS:**

#### **Minimizing levels of exotic insect and disease pests (B-2<sup>1</sup>, B-21):**

**Potential of each region to have problems with exotic pests:** The North, South, and Pacific Coast have a high **potential** for importing exotic pests compared to the Inland West. These regions contain many ports-of-entry for imported goods that can carry exotic pests. Many exotic pests have already been introduced and are continuing to produce exotic insect and disease outbreaks. A very high concern on the Pacific Coast is the potential introduction of the Asian gypsy moth in wood product imports from Asia. The

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<sup>1</sup> Numbers in parentheses refer to figures ("B-#" in Appendix B) and Tables ("C-#" in Appendix C) which relate to the discussion in this section.

Asian gypsy moth defoliates many coniferous and hardwood trees, similar to the European gypsy moth, but can spread more quickly than the European species. Introduction of additional exotic pests from log imports is also a possibility (Campbell and Schlarbaum 1994).

**Current condition of each region:** Exotic pests are affecting the most area and species in the North. Examples are European gypsy moth, hemlock woolly adelgid, beech bark disease complex, and dogwood anthracnose disease. Significant damage is periodic, dependent upon fluctuation in the environment and populations levels of each individual pest. For example, gypsy moth defoliated 7,304,294 acres of forested land in 1990, but only 880,400 acres in 1994, (USDA Forest Service 1995). Many pests are migrating to the southeastern Appalachian region.

Inland West forests have been affected by the white pine blister rust that has killed many western white pines and whitebark pines. Resistant varieties of the western white pine are now reducing the long-term concern for this species, although the whitebark pine is still in danger. However, eastern forests may be increasingly affected by the disease, as *Ribes* (alternate host) eradication programs are limited. On the Pacific Coast, sugar pine and western white pine are being affected by the white pine blister rust, and a root rot disease (*Phytophthora lateralis*) is threatening Port Orford cedar. There presently do not appear to be exotic pest concerns in Alaskan forests.

The present trend is for the most actual damage from existing exotic pests to be in the North and South, with the Inland West and Pacific Coast receiving the least actual damage. The Pacific Coast, North, and South are becoming increasingly susceptible to new exotic pests as raw logs and wood products are being imported from abroad, particularly from New Zealand and Chile, and potentially from Siberia and the Russian Far East.

**Minimizing catastrophic levels of native insect and disease pests (B-3, B-8, B-9, B-15; C-4, C-5, C-10):**

**Potential of each region to have problems with catastrophic levels of native pests:** Each region has the potential for catastrophic outbreaks of native insects and diseases. Bark beetles pose serious problems in southern and Inland West forests, and spruce budworms are problems in eastern and western forests. The Pacific Coast has occasional outbreaks of the Douglas-fir bark beetle and hemlock looper. Parts of Alaska can have very high levels of the spruce beetle.

**Current condition of each region:** Presently, catastrophic outbreaks from a variety of native pests are occurring across North American forests. Losses

in 1994 resulting from infestations by eastern spruce budworm in the North (1.0 million acres), southern pine beetle in the South (5.3 million acres), and mountain pine beetle and the western spruce budworm in the Inland West (0.4 and 0.5 million acres, respectively) were significant. Dwarf mistletoe reduced growth and killed trees on 28.9 million acres in western forests in 1994. Fusiform rust damaged 13.7 million acres in the South. The spruce beetle has killed trees throughout much of the Kenai Peninsula and elsewhere in Alaska.

Many native pests may not cause outright mortality, but can significantly reduce growth and make trees more susceptible to other pests and disturbances. For example, *Armillaria* root rot disease reduces growth of host tree species over large areas where these trees have become more plentiful in the Inland West. Similarly, dwarf mistletoe has both reduced growth of host trees and made them more susceptible to fires.

Native pest populations fluctuate over time, as with exotic pests, because of environmental and cultural conditions. Periodic outbreaks will probably occur in pine beetles and spruce budworms will probably occur as a response to high stem densities. High stem densities on predominantly public lands in the Inland West means high levels of insects and diseases will occur there. Epidemic outbreaks will probably increase with the native Douglas-fir beetle in the large amount of public land on the Pacific Coast. Increasing numbers of windthrown trees are left in the increased areas where timber removal is excluded by recent changes to federal forest policy. These windthrown trees serve as brood chambers for these pests.

**Minimizing catastrophic levels of native mammals (B-1, B-2, B-20, B-21; C-11):**

**Potential of each region to have epidemic or catastrophic levels of native animals:** Each region has the potential for some native mammal populations to grow to catastrophic or epidemic levels. Various mammal populations fluctuate with habitat, weather, predator/prey relations, hunting, and other factors. The large forest areas interspersed with urban areas in each region and the high timber production and recreation use of the forests mean that people's safety, health, and commodities will periodically be impacted by animals.

**Current condition of each region:** Each region has localized cases where high animal populations are causing concerns for human health, safety, or other values. High deer populations in parts of the North have led to difficulties regenerating forests and--especially in Connecticut where deer hunting was minimal--to concerns about Lyme disease being transmitted from

deer to people. Farming and forestry in many parts of the South and North are being impacted by high beaver populations, which are causing flooding of forests and farmlands. High pocket gopher, porcupine, deer, elk, and bear populations in the Inland West and Pacific Coast are damaging forests being grown for timber. Reductions in open habitats, caused by curtailing harvesting as the older openings regrow, will probably increase the violent encounters between people and bears or cougars in the Inland West and Pacific Coast. These mammal population fluctuations and their consequences will probably become even more common as the United States' population becomes increasingly urban and hunting becomes less common.

**Minimizing catastrophic fire events (B-3, B-8, B-9, B-11, B-15; C-4, C-5, C-10):**

**Potential of each region to have catastrophic fires:** Although each region has the potential for catastrophic fires, their greatest potential is in the Inland West, the Pacific Coast, and Alaska. These areas have high amounts of dead fuel, weather conditions suitable for fires, and relatively inaccessible areas. The frequent burning, relatively low timber volumes, small amounts of dead fuel, and accessibility of forests in the South results in less potential for catastrophic fires. The climate of the North is usually not conducive to fires (low potential), except during periods of drought or following catastrophic windstorms.

**Current condition of each region:** The relatively moist, cool climate of the North makes fire danger relatively low, even though the low harvest and high tree mortality rates is progressively adding fuel. The South has a higher proportion of dry weather, creating a greater potential for fires. Increases in dry fuel in southern forests occurs following hurricanes, tornadoes, and epidemic insect outbreaks. The fire danger in the South has been mitigated by a proportionately large amount of harvesting and a wood harvesting and road infrastructure to proactively salvage fuels (dead and dying trees) following catastrophic events. Additionally, a relatively dense road system exists (compared to western forests), allowing rapid accessibility to fuels and fires in southern forests.

The Inland West has high fuel buildups (dead and dying trees), low accessibility, and little infrastructure of roads and facilities. Much of the inaccessible lands are in public ownership with intermingled productive and

nonproductive forests<sup>1</sup> and grasslands. These publicly owned lands contain high fuel volumes (dead and dying trees; O’Laughlin et al. 1993). Millions of acres of forests have been burning annually, and this is expected to continue for the next few decades (Sampson and Adams 1994).

Federal lands and National Parks on the Pacific Coast from California to Washington also contain buildups of fuel caused by protection from ground fires and by windstorms. Fires in the Pacific Northwest occur less frequently than in the Inland West, but can be even more catastrophic because of the high fuel volumes (dead trees). The limited road system and infrastructure make federal lands in this region especially susceptible to catastrophic fires. The trend is toward increasing fires in the Inland West and Pacific Coast, both areas of predominantly public (federal) lands, for the following reasons:

1. Presently dead, dying, burned, and/or insect/disease infested timber is allowed to accumulate on federal lands because of recent administrative and court actions, and;
2. Thinning or salvage of dead trees is prevented in riparian zones (areas along streams in eastern Washington and Oregon) and in reserves.

Except for Southeast Alaska (the Tongass National Forest), forests in Alaska are highly susceptible to fires because of the high fuels created by mortality from insect attacks and the lack of human, equipment, and road infrastructures.

**Minimizing losses from catastrophic wind and other “natural” events (B-12, B-18, B-21; C-1, C-2):**

**Potential of each region to have other catastrophic events:** The South and the Pacific Coast are both subjected to frequent, stand-replacing windstorms and flooding from ocean-originated storms (e.g., hurricanes). The North receives such storms less frequently than the South. The Inland West receives relatively few such storms. Such storms are infrequent in Alaska, except in Southeast Alaska. Pacific Coast and Alaskan forests are susceptible to rare volcanic eruptions.

There is a concern that atmospheric pollutants (especially CO<sub>2</sub>) may contribute to climatic instability and cause extreme weather episodes (e.g.,

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<sup>1</sup> “Productive” forest land is that capable of growing 20 cubic feet/acre/year in non-managed stands and not legislatively or administratively reserved. Productive and non-productive forest area in each region is shown in Tables C-1 and C-2. Productive forests will primarily be referred to, since these are most capable of providing the different value--and are under most contention for management approaches.

excessively cold, hot, dry, and/or wet conditions). These climatic extremes may cause catastrophic mortality of species in large parts of their ranges. Losses of property, timber, habitats, and other values will be greatest in those forests where management is difficult because of lack of access, legal limitations, or the lack of management infrastructure (labor, equipment, roads, and management skills, experience, and local knowledge).

**Current condition in each region:** The potential for very hot, sustained fires is great in Pacific Coast forests, where there are many windthrown trees from recent storms (Inaugural Day Storm of 1993, windstorm of December, 1995). A high percentage of these forests are under federal ownership where salvage operations are limited by current policy. Moreover, these lands are relatively inaccessible, contain high timber volumes, include large areas of reserves, and have a declining harvesting and manufacturing commodity infrastructure necessary for removal and processing of the dead trees. There are fewer problems of wind- or flood-caused forest damage in the Inland West and Alaska. Recovery after a catastrophe will be difficult, however, since the large amount of federal lands in these regions have relatively little road, labor, and equipment infrastructure.

The South has had recent hurricanes; however, the infrastructure of roads and harvesting labor, equipment, and mills has allowed downed trees to be removed and the forest to be regenerated, thus avoiding secondary catastrophic events. The North has not recently had extensive windstorm damage. This region also has an intermediate labor and manufacturing infrastructure (but a good road system), and is moderately capable of minimizing loss of timber and growth, habitats, and other values from such disasters.

## **SUSTAINING THE GLOBAL ENVIRONMENT**

### **Atmospheric carbon dioxide (CO<sub>2</sub>) and other pollutant buildups (B-11, B-12, B-19; C-3, C-4, C-6 through C-10):**

**Potential of each region to reduce atmospheric CO<sub>2</sub> and other pollutant buildups:** The North and South have high potentials for keeping CO<sub>2</sub> out of the atmosphere, as their large forested areas can sequester much carbon through growth. The relatively fast growth rates mean that more timber can be harvested and used to substitute for energy-intensive and high-CO<sub>2</sub>-producing building materials such as steel, aluminum, plastic, concrete, and brick. The South has more rapid growth, and therefore, a greater ability to produce timber. The cooler climates of the North can sequester more carbon in the soil and other dead organic matter. Both regions have large areas of

marginal agricultural land which could sequester more carbon if converted to forests.

The Pacific Coast has a high ability to produce timber products from forests to substitute for more CO<sub>2</sub>-producing products, as well as a high ability to sequester carbon in the living and dead organic matter. This region is relatively limited in total forest area compared to the South and North.

Alaska has a high ability to store carbon in its large areas of productive and non-productive forests and other vegetation area. Despite this ability, Alaska has a relatively low potential to produce timber products as substitutes for more polluting products because of its limited commercial timberlands.

The Inland West has a low potential to increase CO<sub>2</sub> sequestration because it has a limited area of productive timberland within its vast area. In addition, the major woodland and forest types of the region are fire-dependent ecosystems, with fire being the major recycler of carbon. Decades of fire suppression have contributed to a buildup of dead and dying trees, which do not readily decompose but will readily burn in the dry climate. Unless proactive treatments are done, exceptionally large, intense wildfires will result in significant CO<sub>2</sub> emissions from these forests during the next 20-30 years.

**Current contribution of each region:** Forests in the North and South are both contributing moderately to their potential for carbon sequestration, but for different reasons. The North is sequestering relatively large amounts of carbon in its standing forest, because the forests are relatively old (calculated average relative age of 39 years<sup>1</sup>) compared to the South (25 years). The South is keeping CO<sub>2</sub> out of the atmosphere by harvesting a large amount of timber (74 percent of its gross growth)<sup>2</sup> compared to northern forests (40 percent).

The Pacific Coast had been contributing much to keeping carbon out of the atmosphere relative to its potential, since its forests were relatively old (calculated average relative age 53 years), contained large volumes of timber (indicating large storage of carbon), and were harvesting 73 percent of its gross growth<sup>3</sup>. Since the late 1980's, major reductions in federal timber harvests have occurred because of concerns for protecting late-successional forests and related species. Consequently, these forests are contributing

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<sup>1</sup> U.S. Forest Service RPA assessments do not estimate stand or forest ages; therefore, relative age (not to be confused with actual age) is calculated for this report by dividing the standing volume by the annual growth (Table C-4).

<sup>2</sup> (91% of the South's net growth, compared to 52% for the North; for more details, see Table C-3.)

<sup>3</sup> The Pacific Coast was harvesting 88% of its net growth; the Inland West, 38%; and Alaska, 75%.



less timber as substitutes for more polluting products; further, many of the reserve areas are increasingly likely to burn. Both of these factors will add CO<sub>2</sub> directly to the atmosphere.

Dry forests on federal lands of the Inland West have become heavily loaded with dead trees from many decades of fire suppression coupled with reductions in harvesting or removal. Only 29 percent of the gross growth is being harvested in this region. These forests will eventually burn, resulting in a net increase in CO<sub>2</sub> for the region.<sup>1</sup> Alaska also contains many forests which will burn in the near future, since harvesting is only 50 percent of gross growth. Consequently, Alaska is not increasing carbon sequestration nor is it providing timber products to offset more polluting substitutes.

**Conserving native forests in other countries (B-11, B-12; C-3, C-4, C-6 through C-10, C-15):**

**Potential of each region to contribute to conserving these forests:** The United States contains 5 percent of the world's population, 8 percent of the world's forests, and 7 percent of the world's timber inventory (Brooks 1995). The United States is one of the major population centers and utilizes a substantial amount of timber in residential construction. If this wood is imported, there is direct and indirect pressure to harvest wood from countries where there are fewer environmental controls on timber harvest (Perez-Garcia 1993).

The United States could meet its current domestic wood needs and export an additional 4 percent of the world's consumption if we harvested as much wood as we grow. The potential of each region to supply wood is directly related to its potential to provide timber volume and quality, discussed below in Part 2.

**Current condition of each region:** The United States harvests about 52 percent of its annual gross timber growth<sup>2</sup>. It is currently consuming as much forest products as it is producing (harvesting; i.e., its exports and imports of wood products are balanced when measured in volume).<sup>3</sup> There have been increasing harvests and imports of wood from elsewhere in the world to the

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<sup>1</sup> For example, recent wildfires in the Boise National Forest have been estimated to emit 83 tons of CO<sub>2</sub> per acre. Forest treatments, including fuel removals and prescribed burning, would result in 15-20 tons of CO<sub>2</sub> per acre.

<sup>2</sup> 65% of its net growth, gross growth reduced by mortality.

<sup>3</sup> Information courtesy of Dr. Irene Burkak, USDA Forest Service Research. Net imports and exports of specific forest products (e.g., lumber, logs, pulp, etc.) vary.

Pacific Northwest (Perez-Garcia 1993) since the recent curtailments of timber harvesting in the Pacific Northwest.

The greatest production of domestic wood relative to its growth had been coming from the South and Pacific Coast, with intermediate contributions from Alaska. This harvest had helped offset imports of wood. The Pacific Coast has been making less contribution following recent curtailment of federal timber harvest, with the result that wood imports have increased. Because little wood is harvested in the Inland West and North relative to their potentials, these regions make little contribution toward avoiding wood imports. The Inland West, Pacific Coast, and Alaska will probably provide even less wood within the next few decades since destructive forest fires are progressively increasing in federal forests in these regions.

Forest harvesting intensity varies with types of landowner and among regions as well. The greatest intensity of forest harvest is on industrial lands, where harvesting currently exceeds growth. Non-industrial private landowners are removing (harvesting or otherwise removing; see Table C-3, Appendix, for definition) about 53 percent of the gross timber growth, and harvesting is between 39 and 45 percent of the gross growth on public forests (as of 1992).

## **ENSURING PLANT AND ANIMAL DIVERSITY:**

### **Conserving and restoring all native forest types and species: (B-17):**

**Potential of each region to conserve and restore native forest types and species:** Each region contains a few dominant forest “types”; groups of species which occupy similar soils and have similar stand histories and climatic regimes. Each region contains some forest “types” which are plentiful and others which are relatively rare. Agriculture, grazing, fire control, and urban sprawl have most affected forest types and species in the North, South, and Inland West.

**Current condition of each region:** Certain forest types in the North and South have become greatly diminished or threatened largely (but not exclusively) because large areas of forests in these regions have been converted to agriculture and residential areas. In the South, semi-tropical forests in Florida, baldcypress swamps (e.g., south of New Orleans) and some river floodplain forests (now in farms) have been greatly diminished. Many individual species in eastern forests, such as American chestnut, butternut, longleaf pine, white pine, shortleaf pine, and Atlantic white cedar, have also been greatly diminished by overcutting, diseases, and land use conversion since Colonial times.

The Inland West, Pacific Coast, and Alaska have had less conversion from forest land to other uses, and so still contain more representative areas of their native forest types. Fire prevention and white pine blister rust are reducing, respectively, the amounts of aspen and western white pine, whitebark pine, and sugar pine in some areas.

Continued reduction of less common forest types has occurred, as farming intensified on river floodplain forests in all regions and residential expansion and intensive forestry has become concentrated.

**Providing habitats for native species within forest types: (B-1, B-6, B-7, B-10, B-11, B-15, B-16; C-13):**

**Potential of each region to provide these habitats:** There are species in each region that depend upon open and complex structures (Figure 1.3). Other species in most regions depend on other structures as well. Through proactive management, the forests in each region could provide these habitats. Human, proactive management has been done to these forests in various ways for the past 10,000 years.

**Current condition of each region:** Each region except Alaska has a deficiency of one or more stand structures, thereby causing a limitation of habitats for certain species.

Habitat deficiencies in the Inland West, Pacific Coast, and parts of the North and South are largely caused by overcrowding in large areas of forests. These stands are dominated by crowded, small diameter trees and are in the dense structure (Figure 1.3). Most regions contain threatened and endangered species which live in the open, savanna, and complex structures (Table 1.3).

In addition, there has been a general reduction of shade intolerant and fire resistant species such as pines and oaks in the East, and ponderosa pines and western larches in the Inland West. These species are being replaced with more shade tolerant species such as hickories and maples in the North and South and Douglas-fir and true firs (Abies species) in the Inland West.

Eastern hardwood and Inland West forests are commonly about the same age, because of major timber harvesting activity at the turn of the 20th century. Much of this timber harvesting was "high grade harvesting" (a.k.a. "high grading"), a silviculturally discredited harvesting method in which the economically best trees are removed and the remaining trees allowed to

grow.<sup>1</sup> This harvesting, along with forest pests, chestnut blight, blister rust, and exclusion of fires, has reduced the extent of some highly important stand structures and shade intolerant species.

In the North, there is generally a shortage of stands in the open and savanna structures (Figure 1.3). Northern forests are predominantly in non-industrial private ownership, but there has not been as much harvesting as in the South, which has a similar ownership pattern. Stands (especially hardwoods) which have been "high grade" harvested have inadvertently created complex structural features, although there are relatively few stands which have not had any human activities in them or which contain extremely old or large trees.

There are relatively few stands containing the savanna or complex structures in the South. As in northern forests, the high grade harvesting of hardwood forests has provided some complex structural features, but without the very old or large trees. Most of the increase in tree volume has been in hardwoods, and there has been a recent decline in pine tree volume. The large amount of harvesting has produced many stands in the open and dense structures in the South.

The Inland West contains many stands in the dense structure, caused by a combination of increased grazing during the late 1800's and early 1900's, fire protection since the early 1900's, and high grade harvesting. High grade harvesting and the lack of harvesting in many areas (inaccessible or in reserves) has also left some forests with complex structural features. There is a lack of savanna and open structures in many areas, especially on federal forest lands, which comprise most of the region's forests. Because of the increasingly likely large fires on these public lands, there will be dramatic shifts to burned areas which will contain open and savanna structures, but very little of the understory and complex forest structures for many decades.

The Pacific Coast contains the most complex structure with large, old trees, as shown by the proportionately large amounts of large trees and reserve areas. Most of this complex structure is on federal and state-owned public lands, which encompass over 54% of the region's forests. The Northwest Forest Plan (1993) and other recent activities were intended to increase the amount of complex structure by establishing more reserves. However, the increased prospect for catastrophic fires in the contiguous,

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<sup>1</sup> "High grade harvesting" was not endorsed by silviculturists as an acceptable practice because it tended to reduce the genetic quality and diversity and did not achieve its stated objective of sustaining growth of trees useful for timber and relatively free of diseases. Several forms of uneven-age harvesting are available which do sustain such growth, avoid high levels of diseases, and maintain the genetic quality and diversity.

relatively inaccessible areas within reserves may actually decrease the amount of complex forests.<sup>1</sup>

Alaska contains the best distribution of habitats for all species since there has been little activity there and there are very large areas of reserves.

**Ensuring survival and recovery of threatened and endangered species (B-1, C-13):**

**Potential of each region to ensure survival and recovery:** Threatened and endangered species have been identified in all regions. There appear to be representatives in each region which occupy open or savanna or complex structures (Figure 1.3).

**Current condition of each region:** There are rare and endangered species in each forest region. There do not appear to be threats of large scale extinctions of guilds<sup>2</sup> of species. Rather, individual species are threatened and endangered and individual actions to restore population levels may be necessary.

**Protecting native species from invasive exotic plant species (B-1):**

**Potential of each region for displacement of native species by invasive exotic species:** Exotic plant species generally become established on disturbed sites. Eastern forests (North and South) have the greatest potential for exotic species intrusion. Ports-of-entry, high rural populations, and rural industries provide opportunities for invasive exotic species to enter and spread through rural commerce. Forest and range disturbances from the high number of rural residents, road infrastructures, and commercial forestry provide sites for initial establishment. In addition, eastern forest ecosystems naturally contain a wide diversity of habitats and therefore have a higher probability for invasive plants to become established.

Exotic plant pests are not as common in western forests (Inland West, Pacific Coast, and Alaska). Colonization of the western forested regions by European settlers was relatively recent in comparison with eastern states. Rural populations are lower, and land use and access is substantially different and less well developed than in the East. This is especially true on forests owned by federal and state governments, which comprise most of the forests in western regions. Ecosystems are less diverse than eastern forests,

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<sup>1</sup> For example, the Wenatchee fires of 1994 burned up several nest sites of the northern spotted owl--a species which lives in "complex" forest structures.

<sup>2</sup> "Guilds" are groups of species occupying similar habitats.

with the exception of California, and correspondingly offer less opportunity to be colonized.

**Current condition of each region:** Individual exotic plant species have invaded forests primarily in the North and South. These plants include trees, shrubs, and grasses, e.g., Princess tree (*Paulownia tomentosa*), multiflora rose (*Rosa multiflora*), kudzu (*Pueraria lobata*), Japanese honeysuckle (*Lonicera japonica*), and purple loosestrife (*Lythrum salicaria*) (U.S. Congress, Office of Technology Assessment, 1993). Whereas many exotic plants have invaded the Inland West and Pacific Coast, these are primarily grasses and other range plants, rather than plants which become established in forests. Relatively few exotics, if any, have invaded the forests of Alaska.

### **Maintaining genetic diversity and architecture**

#### **Potential of each region to maintain genetic diversity and architecture:**

The North, South, and Pacific Coast have agriculture and urbanization in many areas, which have already left some forest types and species populations isolated. The lower amount of agriculture and urbanization have left the Inland West and Alaska with less of this isolation. Intensive forest management in the South and Pacific Coast includes using artificial regeneration with seedlings which are genetically improved primarily to increase fiber yields and disease resistance. Some artificially produced seedlings are from unspecified origin and unknown diversity. There is potential in these regions for altering local genetic diversity and architecture by replacing local genotypes with seedlings from tree improvement programs or with seedlings from unspecified seed sources with an unknown amount of genetic diversity.

The North and Inland West have a lower intensity of management and there is relatively limited tree improvement in the North. In these regions, regeneration is natural or with nursery-produced seedlings. Some, but not all, of the nursery-produced seedlings are of unspecified origin and unknown genetic diversity. Consequently, there is somewhat less potential for disrupting local genetic diversity and architecture. The introduced white pine blister rust is causing natural selection for resistant genotypes in western white pine and possibly, whitebark pine in the Inland West (if it does not first drive the species to extinction). In the case of western white pine, natural selection is being augmented by artificial regeneration using rust-resistant seedlings from tree breeding programs. Alaska has very little tree improvement or planting efforts, and therefore, a high potential for maintaining the natural genetic diversity and architecture.

**Current condition of each region:** The planting of seedlings from unspecified seed sources and with unknown genetic diversity and architecture may be impacting genetic diversity and architecture in all regions, with the exceptions of Alaska--where tree planting is rare. The advancement of artificial regeneration, including clonal plantations, in the South, and the isolation of some populations by farms and urban areas make it most susceptible to losing genetic diversity and architecture of some commercial species. A similar situation exists in Pacific Coast, though on a relatively smaller scale, making this region somewhat less susceptible to losing local genetic diversity and architecture than the South.

Less intensive genetic improvement efforts in the Inland West and North make these areas less susceptible to altering local genetic diversity and architecture of commercial species. However, agriculture and urbanization may eliminate isolated populations in the North and so cause a loss of genetic diversity.

The Kenai Peninsula of Alaska is an area of dramatic natural genetic hybridization among coastal and interior species. The catastrophic outbreak of the spruce beetle, death of the naturally hybrid spruces, and possibly resulting catastrophic fires may reduce the amount of natural hybridization. This will cause a reduction in genetic diversity and an alteration of the local genetic architecture in this area.

## **ENSURING THE PRODUCTIVITY OF FUTURE FORESTS**

### **Maintaining site quality (B-11, C-6):**

**Potential of each region to maintain the site quality:** Site quality (potential of the soils and climate to support growth) of the South is generally relatively high, in part because of the climate and ability of the soil to redevelop rapidly after erosion. Soils of the Pacific Coast vary between being extremely productive for tree growth and being moderately poor. Soils of northern forests are typically only moderately productive because of a cooler climate, in comparison to the South. The Inland West contains local areas of productive soils, but the least total area of highly productive soils and has the least ability to recover from degradation caused by erosion or compaction. Additionally, the Inland West also does not contain large areas of “productive” forests<sup>1</sup>. Alaska contains relatively small areas of productive forests and moderately productive conditions.

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<sup>1</sup> <sup>1</sup> “Productive forest” is used to define forest areas capable of growing more than 20 cubic feet/acre/year under natural conditions. “Productive” is also used as a relative term; e.g., “highly

**Current condition of each region:** The relatively low level of harvesting in the North has allowed these forest soils to recover from an earlier time of intensive, somewhat primitive agriculture. Consequently, these soils are in relatively good condition for growth relative to their geomorphologic potential.

The past relatively primitive agriculture in the South left many of the abandoned fields in poor condition relative to their potential. Those lands reverted to forests over the last 50-60 years. Although forest growth has helped renew these soils, the relatively short rotation harvesting done in this region has kept these soils from developing to their full productivity.

Much of the forest in the Inland West grows on relatively poor sites because of harsh climate (dry and/or cold) and infertile soils. Site quality is likely to be further damaged when impending, abnormally intense wildfires fueled by excessive fuels cause severe soil damage. The very hot fires are likely to reduce the productivity further both by baking the A-horizon and by creating erosion. The resulting site damage may mean long-term conversion from forest types to brush fields, particularly on drier sites.

Sites in the Pacific Coast and Alaska are quite productive relative to their potential. Most of these areas have not had agricultural rotations, and the forest practices have been quite protective of the soils.

### **Sustaining watersheds (B-11, C-6):**

**Potential of each region to sustain watersheds:** Contrary to common belief, no stream is or has been sediment-free. In fact, sediment transport and dissolved minerals are important to sustain many functions of watersheds. Free-flowing streams transport sediment and nutrients constantly, and need periodic inputs of both to function effectively. In many regions, management practices such as poorly designed road building have contributed to excessive sediment loads, which have damaged spawning beds and altered stream morphology. Nutrient inputs have also been affected by forest management activities, with varying effects, both on vegetative growth, water quality, and stream ecology. Generalizations regarding these effects are seldom accurate, since conditions vary widely, even within regions.

The relatively gentle topography, high rainfall ensuring ample vegetative soil cover, and older geologic formations cause watersheds in the North and South to be more stable than soils in other regions in terms of siltation.

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productive” means capable of growing much more than 20 cubic feet/acre/year. (U.S.D.A.Forest Service RPA definitions).



Changes in watersheds because of past settlement, agriculture, and other land use impacts have occurred, but watersheds in many areas have begun to re-stabilize under the forest recovery of the 20th century. Changes in soil and water acidity and nutrient cycles have been associated with changes in forest type (conifer/deciduous), and localized impacts from airborne pollutants have been identified

The Pacific Coast and Alaska are characterized by areas of geologic uplift, steep topography, and common “rain-on-snow” events, which can lead to dramatic floods. These events make Pacific Coast and Alaska watersheds more likely to be disrupted. Interior Alaska forest areas are more resistant to disruption, because of a more level topography.

Watersheds in the Inland West are subject to major disturbances. The soils on many sites are susceptible to erosion because of a combination of soil parent material, climate, topography, and vegetation. Droughty conditions interspersed with intense summer storms and rain-on-snow events, which occur on steep, broken topography and with sparse vegetation cover, can cause severe erosion in this region.

**Current condition of each region:** The basic geomorphology and present “best management practices” approaches (Binkley and Brown 1993) to forest management have made forest watersheds in the North and South capable of sustaining high water flows.

In the Inland West, recent and impending catastrophic wildfires have and will temporarily increase(d) stream temperature and content of suspended and dissolved solids in many watersheds.

In the Pacific Coast and Southeast Alaska, the environment and steep topography will continue to cause mass erosion. This erosion is sometimes exacerbated by improperly located roads. Limited management practices on recently established federal reserves will, over time, raise the probability for catastrophic wildfires in the Pacific Coast. The result will be further temporary increases in stream temperatures and increased dissolved, suspended, and bedload solids transported in many watersheds--with associated altering of the watersheds.

### **Maintaining the forested land base (B-14, B-20):**

**Potential of each region to maintain its forest land base:** As of 1992, the greatest forest areas are in the South (212 million acres) and North (168 million acres), with the Pacific Coast having the least forest acreage (87 million acres). The Inland West and Alaska contain 140 million and 129 million acres of forest land, respectively (Powell et al. 1993).

With respect to productive forests<sup>1</sup>, the South and the North still have the largest land areas (199 million acres and 158 million acres, respectively). These regions have lost only a small amount of productive forest acreage, and further losses are occurring very slowly. The Inland West has 63 million acres of timberland<sup>2</sup>. The Pacific Coast had 55 million acres in timberland in 1991, but this has been reduced by about 6-8 million acres because of recent federal changes in forest policy. Alaska has only a small amount of productive forest land base (15 million acres), since most forests have very poor growth potential.

**Current condition of each region:** The forested area in all regions has remained extremely stable for the past forty years. This trend is likely to continue. There is evidence, however, that much of the area that is classed as forested or in productive timberland may not be actively managed for timber products. Fragmentation of large tracts into small tracts may make management less economical. There have been major increases in the number of landowners holding small parcels, with a 1994 estimate of 9.9 million owners and 20 percent of the forest area in ownerships of less than 50 acres each (Birch 1996).

Urbanization of many timberland areas also may impact management. For example, about 26 percent of all timberland area and timber volumes from Virginia to Alabama was actually in a Metropolitan Statistical Area (DeForest et al. 1991).

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<sup>1</sup> "Productive forests" are those capable of growing over 20 cubic feet/acre/year under natural conditions (U.S.D.A.Forest Service RPA definitions).

<sup>2</sup> Timberland is referred to as productive forests which are not legislatively or administratively withdrawn from timber management (U.S.D.A.Forest Service RPA definitions).

**II. VALUES EXPRESSED AS CONTRIBUTIONS TO THE QUALITY OF  
HUMAN LIFE (BUT NOT DESCRIBED ABOVE)  
(TABLE 1.1B)**

**TIMBER PRODUCTS:**

**Timber volume (B-4, B-5, B-7, B-11, B-13; C-3 through C-9):**

**Potential of each region to provide timber volume:** The greatest potential for producing timber is in the South, because of its high productivity and large productive timberland<sup>1</sup> area. The North is second in timber producing potential, because of its intermediate productivity and large area. The Pacific Coast is third, the Inland West is fourth, and Alaska has the least potential for timber production. There is great variability in timber growth potential within each region, however. Parts of each region have high potential for timber production (e.g., parts of Idaho and Montana in the Inland West and parts of Southeast Alaska).

Nonindustrial private forest landowners own most of the productive forest area in the U.S. (59 percent), followed by National Forests (17 percent), forest industry (14 percent), and other public owners (10 percent). Most of the productive timberland area in the North (71 percent) and South (70 percent) is owned by non-industrial private owners. Most productive timberland<sup>1</sup> in the Inland West (67 percent), Pacific Coast (53 percent, prior to the Northwest Forest Plan of 1993), and Alaska (60 percent) is owned by federal or state governments. Forest industry owns less than 23 percent of the forest land area in any region.

**Current condition in each region:** The North (40 percent) and Inland West (29 percent) were harvesting the smallest portions of their gross annual timber growth as of 1991<sup>2</sup>. The South and Pacific Coast were removing about 75 percent of gross annual growth and Alaska was removing about 50 percent of its gross annual growth (Powell et al. 1993).

Harvest share of annual growth also differed significantly by ownership. As of 1991, National Forests were harvesting only 45 percent of their annual

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<sup>1</sup> Timberland is referred to as productive forests which are not legislatively or administratively withdrawn from timber management (U.S.D.A.Forest Service RPA definitions).

<sup>2</sup> Harvest as a proportion of net growth values are: North, 52%; Inland West, 38%; South, 91%; Pacific Coast, 88%; and Alaska, 89%.

gross growth<sup>1</sup>; nonindustrial Private Forests were harvesting about 53 percent of their gross growth each year; and forest industry was harvesting about 5 percent more than its annual gross growth.

The National Forests were harvesting much less than their annual growth increment because of logistic, legislative, administrative, and bureaucratic restrictions. The President's Northwest Forest Plan of 1993 further reduced harvest levels on public lands from 1991 levels. The forest industry was harvesting more timber volume than it was growing as of 1992, because it was converting from old stands and hardwoods to fast-growing conifer plantations.

The forests of all regions except the Pacific Coast and Alaska had an increase in standing timber volume during the past four decades. Pacific Coast forests had a reduction in volume of about 20 percent from 1952 until 1982, and have had a nearly stable volume since. Despite that, the standing volume per acre was still higher in the Pacific Coast than any other region.

On average, timber harvest (and other removals) comprise only 75 percent of net growth (60 percent of gross growth) for the nation, indicating considerable opportunity for increased timber production. However, timber supplies at regional and local levels differ from averages. The most important timber species in the United States--southern pines--are being removed at a 14% greater annual rate than they are growing (net annual growth). Softwood (conifer) growth and removals also are almost in balance in the Pacific Northwest. The greatest timber surpluses are in the North and South, but they consist of hardwoods, which presently are in less demand for timber--especially at small diameters. If conifer timber declines through overharvest and regrowth of the forests to hardwoods (broadleaf species) or is excluded from harvest (e.g., reserves on National Forests) in other regions, it is uncertain to what extent the United States will increase harvest of hardwoods, shift to substitute products, and/or import conifers from abroad.

These statistics suggest that timber supply at regional and local levels differ from averages. Timber availability is an issue in addition to the actual timber inventory levels, especially on public and non-industrial private forest lands. Urbanization, water quality protection, wetland protection, endangered species restrictions, public opinion, and landowner objectives (hunting, second homes, or recreation) also may limit the availability or increase the costs of timber.

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<sup>1</sup> Harvest as a proportion of net growth values are: National Forests, 61%; Non-industrial private forests, 66%; forest industry, 124%.

**Timber quality (B-4, B-6 through B-10; C-3, C-4):**

**Potential of each region to provide timber of high quality:** All regions have the opportunity to provide high quality timber, but with different characteristics. The most productive soils of the South and Pacific Coast make it possible to produce large diameter trees, one form of timber quality. The North and Inland West have the potential to provide moderate diameter trees with narrow growth rings (and large trees in some cases), another form of timber quality. Southeast Alaska (Tongass National Forest) has the opportunity to grow trees of large diameters, while the Chugach National Forest has the opportunity to grow smaller trees with narrow growth rings.

**Current condition in each region:** The Pacific Coast still has the most high quality, large diameter trees, and correspondingly, is nearly achieving its potential production. All other regions contain the greatest volume in small diameter trees (trees of 12 inches diameter and smaller). Because of slow growth, the small diameter trees in the Inland West, and to some extent in the North, contain trees with certain high quality properties which fast growing, young trees of the same diameter in the South and Pacific Coast do not have.

During the past four decades, the increase in timber growth in all regions has been in trees of small diameters. Until 1987, there was a dramatic reduction in trees of large diameters in the Pacific Coast, although this region still contains the greatest proportion of its volume in trees of large diameters.

Most of the large diameter trees are on public lands, especially in the Pacific Coast, Inland West, and Alaska where the forests have not previously been harvested. The relatively small amount of federal land in the North and South also contains a large proportion of the high quality timber.

Recent changes in federal forest policy have made much of the remaining large diameter timber in the Pacific Coast unavailable. This recent reduction in availability of large diameter logs has led to increased thinning of stands outside the reserves in the Pacific Coast to obtain timber and to improve future timber quality .

**Selected species (B-15, B-16; C-4, C-5, C-7, C-8, C-9):****Potential of each region to provide selected species for wood products:**

Pine, Douglas-fir, spruce and other conifer species are generally utilized for high volume timber products manufacturing uses, such as house and building construction and paper uses. Hardwoods (non-conifer species) are generally used for such products as cabinets, furniture, and floorings; and lower density hardwoods are increasingly used as raw material for structural

products. Hardwoods are also used for making paper. The Pacific Coast, Inland West, and Alaska have the potential to grow most of their timber using coniferous species. The South has the potential to grow a large proportion (e.g., 50%) of its volume in pine species. The North has some potential to grow coniferous species, but not as great as the South.

National forests hold the largest standing amount of conifer (softwood) volumes (41 percent of the nation's total), followed by the non-industrial private forest landowners (32 percent). Non-industrial private forest landowners are growing the most of the nation's annual softwood volume, at 41 percent (gross growth). The percentage of the nation's conifers grown on public lands, including National Forests, is 35 percent and on forest industry lands is 25 percent.<sup>1</sup> Non-industrial private forestland owners hold by far the majority of the nation's hardwood volumes (72 percent) and annual gross growth (73 percent)<sup>2</sup>.

**Current condition in each region:** Most of the increase in timber volume in the North and South has been in hardwoods, not the conifer timber species which have been traditionally preferred for high volume timber product manufacturing. Technological advances have made hardwoods more useful for production of structural and non-structural products, and their prices have increased, but the most desirable species are not regenerating well. In the Inland West, much of the increase in timber volume has been in relatively low quality true firs and Douglas-fir, not in the target pine species. In the Pacific Coast, the increase in volume has been in Douglas-fir and pine species. (Coastal Douglas-fir is a more "preferred" variety than Inland West Douglas-fir.) In Alaska, much of the growth has been in spruce forests.

A greater proportion of conifer timber has been harvested than hardwood timber. The South, in particular, has been harvesting about 12 percent more conifers than it was growing (net growth) as of the last forest inventory cycles in each state (Cubbage et al. 1995). In the West, annual conifer net growth approximately equalled removals as of 1991, although the growth/harvest ratio varied dramatically between regions.<sup>3</sup>

On industrial forests in all regions in 1992, more conifers were being harvested than were growing. In the South, non-industrial private forestland owners and National Forests were also harvesting more conifers than they

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<sup>1</sup> Net growth of conifers is 32% of the nation's total for public, 41% for non-industrial private, and 27% for forest industry. For more values, see Tables C-3, C-7, C-8, and C-9.

<sup>2</sup> 74% net growth of hardwoods is on non-industrial private forest lands.

<sup>3</sup> In 1991, the Inland West was harvesting 40% of its net growth, while the Pacific Coast was harvesting 96% of its net growth and Alaska was harvesting 137% of its net growth. Removals relative to gross growth for each region were: North, 45%; South, 94%; Inland West, 31%; Pacific Coast, 80%; Alaska, 64%.

were growing. This current trend of harvesting more conifer timber than is being grown does not imply an immediate shortfall of conifers, since there is 18 times as much conifer volume in the South as is being harvested each year. If overharvesting were to continue, however, the practice could limit the ability of the region to achieve various forest values.

#### **Non-timber, non-wildlife products:**

**Potential of each region to provide non-timber and wildlife products:** All regions have the potential to provide products and services other than timber. The type of each product and service varies by region and specific characteristics within each region.

**Current condition in each region:** Little information is available on the potential of each region to provide non-timber products and services.

#### **Reserve areas (B-21; C-1, C-2, C-11):**

**Potential of each region to provide reserve areas:** Alaska has the greatest potential for reserve areas, since this area contains the lowest rural population, the most currently reserved area, and the greatest amount of government land. Using these criteria, the Inland West is second and the Pacific Coast is third in potential to provide reserved areas. The North and South have the lowest potential for such reserve areas because of the currently small area in reserves, high rural populations, and small amount of government land. Timber harvests, especially for high quality timber, on National Forests are very important to rural economies in the same proximity.

The North and South have fewer areas of non-productive forest and other land which could readily be designated as reserves, without displacing other high economic uses.

**Current condition in each region:** The greatest total areas set aside from timber and other commodity production is located in the Inland West, Pacific Coast, and Alaska. The productive reserve area in the Pacific Coast was greatly increased with the Northwest Forest Plan of 1993. The North and South have very little total land in reserves. However, the North has as much productive, federal forest land in reserves as the Pacific Coast or Alaska, while the South has about one half of this amount.

#### **RECREATIONAL OPPORTUNITIES:**

#### **Remote recreation opportunities (C-1, C-2, C-11):**

**Potential of each region to provide remote recreation opportunities:**

Recreational opportunities can occur on both productive forests and other areas. The potential for remote recreational opportunities is a combination of the proximity to the population and the availability of remote land. Most of the population of the United States is in the North and South, with a moderate amount in the Pacific Coast and relatively few people in the Inland West and Alaska. The federal ownerships in the Inland West, Pacific Coast, and Alaska contain the largest amounts of relatively isolated, unroaded areas. The North and South have limited availability of remote land and the Inland West and Alaska are limited in their ability to provide remote recreation by their low populations. Consequently, there is a low potential for remote recreation in the North, South, Inland West, and Alaska by the general public. The Pacific Coast seems to have a balance of these two conditions, and a high potential for remote recreational opportunities by the general public.

**Current condition in each region:** The North (7.5 million acres) and South (15.1 million acres) contain relatively little land for remote recreation, while the Pacific Coast (40.6 million acres) contains a moderate amount of land for remote recreation. The Inland West (96.7 million acres) and Alaska (135.1 million acres) contain the largest amounts (Watson 1989).

**Accessible recreation opportunities (C-1, C-14):**

**Potential of each region to provide accessible recreation opportunities:**

Accessible recreation opportunities on private and public ownerships can occur on both productive forests and other areas. The potential for accessible recreation opportunities is a combination of the proximity to the population and the availability of forest and other land that can be used for recreation. All areas have large land bases for accessible recreation (Watson 1989); most of the population of the United States is in the North and South, with a moderate amount in the Pacific Coast and relatively few in the Inland West and Alaska.

**Current condition in each region:** All regions of the United States contain at least half as much accessible recreation land as total, productive forest land; consequently, all regions appear to have high potential for accessible recreation.

**RURAL LIFESTYLE**



**Commodity -dependent lifestyles (B-20, B-21; C-6, C-11, C-12):**

**Potential of each region to provide lifestyles for commodity-dependent communities:** The South has the greatest potential to sustain high timber harvest rates and associated jobs, because of its productive sites (soils and climate) and large forested area. However, only a small proportion of the population could be involved in commodity resource jobs, since the South has large rural and urban populations.

The North has an intermediate potential for commodity-dependent lifestyles using locally produced timber, because of relatively slower timber growth rates. Correspondingly, a smaller proportion of the large urban and rural population could be involved in commodity resource jobs than in the South.

The Pacific Coast has an intermediate potential to provide resources to support harvesting and manufacturing activities and associated jobs. Although the Pacific Coast is characterized by very productive sites (soils and climates), it has a relatively small forest area. The smaller population (compared to the North and South) means that a relatively large proportion of its population could be involved in jobs related to commodity resource extraction and conversion.

The Inland West and Alaska both have relative low potentials to provide the commodity-based resource lifestyle because of their relatively small productive forest areas and relatively low growth potentials. The small populations in both regions mean a relatively large proportion of the populations could be involved in commodity resource jobs.

**Current condition in each region:** The high harvest rates relative to growth (1991 data) indicate the South and Pacific Coast had been realizing much of their potential to provide commodity resource jobs--and lifestyles. Recent curtailments of timber harvest in the Pacific Coast have caused this lifestyle to decline in the Pacific Coast.

The North, Alaska, and Inland West provide relatively few timber harvest jobs, and lifestyle, compared to their potentials, since these regions are harvesting a small proportion of their timber growth. Curtailments of timber harvest in the Inland West and Alaska during the past few years have further reduced this lifestyle.

**Non-commodity-dependent lifestyles (B-11, B-17, B-18, B-20, B-21; C-1, C-14):**

**Potential of each region to provide lifestyles for non-commodity-dependent communities:** All regions have positive and negative factors for

providing these lifestyles. The South and North have good road access to the forests, high populations, and an infrastructure that allows rapid response to catastrophes that can destroy forests and homes. However, the North and South do not have large areas of reserved or unreserved public lands nor as much of the spectacular scenery and isolation as many places in western regions.

The Inland West, Pacific Coast, and Alaska have the advantage of large areas of public lands for such “non-extractive” communities to use for recreation and scenery. However, these regions do not have the high populations, good road access, and infrastructure to avoid and recover from catastrophes.

**Current condition in each region:** The relatively small tree sizes and frequent harvesting in most of the South reduces the aesthetic value of these forests. The north has less harvesting and so provides a more closed forest appearance for those with a “closed forest” aesthetic inclination.

In the West, the remoteness of forests to many sources of non-commodity incomes limit this lifestyle to those capable of living in relatively remote areas. This lifestyle is in danger of being markedly reduced in all three western regions by high risk of wildfires on public lands and associated high costs of fire insurance on buildings. This risk has increased as active management and road maintenance has declined during the past few years.

All regions have great potential for increased forest recreation and forest-based tourism. However, aesthetic and recreational attributes of western forests are increasingly at risk as the threat of catastrophic fire increases.

#### **Earnings, employment, and value-added (C-1 through C-4, C-11, C-12, C-14):**

**Potential of each region to provide earnings, employment, and value-added:** Increased forestry sector infrastructure, employment, and value added can contribute significantly to local economies throughout the United States. Both timber harvest revenue and recreational income can be increased based on current timber supply levels from forests and increasing timber/recreation demands. Relatively high levels of unemployment in rural forested regions should offer an ample supply of workers. Skill levels are variable, but training programs could improve the talents of the job base, as well as target specific skills for specific employment needs.

The value-added portion of the forest economy is closely related to wood quality. In the short term, relatively large diameter hardwoods in parts of eastern forests and large diameter conifers in the Pacific Coast have the greatest potential for enabling value added manufacture. In the long term, all

regions could provide greater levels of added value products and employment than they do now.

Employment in recreation is directly related to the level of recreation. There are high opportunities for accessible recreation (described above) in each region.

Earnings are generally higher in the manufacturing portions of the forest economy than in recreation. Consequently, the greatest potential for forest based economic activity is in the South, which has the greatest potential for timber production. The North and Pacific Coast are next in potential, with the Inland West and Alaska, least.

**Current condition in each region:** The forest management, pulp and paper manufacturing, and solid wood manufacturing sectors comprise about 1.2% of total U.S. employment, and generate 1.4% of U.S. Gross National Product (American Forest and Paper Association 1995). Despite this modest absolute percentage, this represents a large relative share of the total U.S. economic activity given the hundreds of different economic sectors.

The economic impacts of forest-related earnings, income, and value added are proportionately greater in the South and the western regions, where the bulk of U.S. processing facilities exist. Recent curtailments of federal forest management in the Pacific Coast, Alaska, and Inland West are further reducing the infrastructure of processing facilities, roads, and skilled people in these regions.

Forest-based recreation also is important to the economy in all regions.

Rural forest areas in the North and South generally have better roads and services such as police and fire protection, schools, water, and waste disposal--largely because most forests are owned by non-industrial private owners. Rural forests in the Inland West, Pacific Coast, and Alaska have poorer such infrastructures, largely because of predominantly public ownership.

Among the regions, the South is providing the most jobs through timber harvest and forest products manufacturing. This region has the potential to provide more jobs with increased harvest of hardwoods and, in the long run, with growth of higher quality timber.

The Inland West is providing relatively few timber-based jobs because of a low rate of harvesting in total amount and as a proportion of tree growth. This region is providing some jobs in recreation.

The Pacific Coast is providing an intermediate number of jobs in timber production. There were more jobs in this region before curtailments of harvesting on National Forests reduced the total timber harvest by about 15 to 20%. The region provides some jobs in recreation.

Alaska is providing relatively few jobs in timber production because of the relatively low level of timber harvested there.

The potential for increasing forest management and timber harvest jobs through increased harvest are greatest in the North, followed by the South and Inland West, and are lowest in Alaska and the Pacific Coast. Alternately, the potential for increased jobs through increased secondary manufacture are possible in all regions, but particularly in the Pacific Coast region, which in the past has focussed on primary manufacturing.

### **Water volume and usefulness (B-11):**

**Potential of each region to provide water volume and usefulness:** The usefulness of water in each region is related to its stability of flow, temperature, and amount of sediment carried. These are affected by forest practices, roads, recreation, and natural disturbances and forest regrowth--as well as by conversion of land to non-forest uses. All regions have the potential to provide appropriate flows of water with desired temperatures and sediment loads for much of the time, if the watershed condition is protected from both adverse natural disturbances and adverse management practices. It must be recognized, however, that occasional natural (or human) events will create periodic, short term problems with water usefulness.

Water volume can be locally and temporarily increased with forest harvest and progressively reduced with forest regeneration and growth. Long term water volume, however, is related to rainfall, which is subject to climatic fluctuations. Consequently, Alaska and the Pacific Coast have the greatest potential to produce water volume since forests in these regions have high precipitation (up to 170 inches/year). The North and South have the next highest potential to provide water volume, with rainfalls of about 25 to 70 inches/year. Inland West watersheds have the lowest potential to provide water volume, with very low precipitation.

**Current condition in each region:** Northern and Alaskan forests are generally realizing their potential to provide useful water. Remnant, poorly built logging roads and inappropriate logging at elevations which can lead to "rain-on-snow" events have created floods and associated problems in parts of the Pacific Coast. The South is still encumbered with heavy sediment loads in some streams and rivers from the effects of early, exploitative agriculture. Stripmining has also affected water acidity in some southern streams. The Inland West is periodically impacted with heavy storms on poorly developed soils, which lead to flash floods and heavy sediment loads.

The impending fires on public lands in the Inland West and Pacific Coast will exacerbate problems with water resources there.

In all regions, continued use by recreationists (e.g., horses, mountain bikes, and “all-terrain-vehicles”) of poorly designed roads and trails is increasing erosion and siltation and so decreasing the usefulness of the water.

### **Game and non-game fish and wildlife (B-1):**

**Potential of each region to provide for game and non-game fish and wildlife:** All regions contain large, forested areas and so have high potential to provide both game and non-game fish and wildlife.

**Current conditions in each region:** The extent to which game and non-game fish and wildlife are provided in each region depends on the conditions of the watersheds and the diversity of habitats. These conditions were described earlier. Alaska currently is providing the most fish and wildlife relative to its potential. Harvesting and regrowth of some harvested areas to the “stem exclusion” stage may be leading to localized declines of deer in Southeast Alaska<sup>1</sup> (Figure 1.3).

The Pacific Coast provides most of the habitats required by wildlife and fish and relatively stable streams and lakes. The stability of habitats and watersheds are threatened, however, by the high risk of catastrophic wildfires and problems with poorly maintained logging roads.<sup>2</sup> The curtailment of even-aged harvesting on large, contiguous areas of federal forests in the past few years is leading to localized shortages of open or savanna habitats (Figure 1.3) and declines of elk, deer, and other species which utilize these structures. Current forest management regulations help protect riparian zones which improves fish habitat.

Except for shortages of savanna and open habitats, the North contains habitats for most species and relatively high quality watersheds in forested areas.

The South has a shortage of “savanna” and older stand structures and so is lacking habitat for some species. Past farming has reduced the quality of some areas for fish habitat; however, current forest management regulations and training courses for commercial loggers are helping to protect riparian zones.

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<sup>1</sup> In this region, deer seem to depend on the complex structure in winter.

<sup>2</sup> Problems with dams, overfishing, and other issues reducing anadromous fish stock are not directly related to forest conditions and so are not addressed here.

The Inland West contains a shortage of savanna and open structures, except in areas already affected by forest fires. Water and fish are not well protected, because of the siltation following these fires. As more wildfires occur, watershed conditions will continue to deteriorate.

## **ECONOMIC VIABILITY OF VARIOUS PRIVATE FOREST LANDOWNERS AND FOREST PRODUCTS AND RECREATION SEGMENTS.**

### **Viability of small, private, non-industrial landowners (B-18; C-1, C-2, C-6 through C-11):**

**Potential of each region to support economic viability of small, private, non-industrial landowners based on forest resources:** Landowners who will potentially profit most from timber production will be those in areas of high site productivity and close proximity to markets--areas of high populations. The South most closely fits this profile, and 70 percent of its forestland is owned by private, non-industrial owners. The lack of public lands for hunting in the South makes leasing of hunting (recreation) rights of private forests to "hunting clubs" a viable business. This leasing sometimes leads to altering timber management to provide more game habitat.

The North has moderate site productivity for producing timber, but is close to markets. A high proportion (71 percent) of northern forests are owned by private, non-industrial owners and so there is the potential for relatively high economic viability.

The Pacific Coast has the factors of high productivity and proximity to internal and export markets (Pacific Rim markets). However, only 24 percent of the forest land is owned by private, non-industrial owners.

Inland West and Alaskan forests have low site productivity and are far from markets. The potential for economic viability for landowners is low. In addition, only 28 percent and 41 percent of the productive timberland is owned by non-industrial private owners in the Inland West and Alaska, respectively.

Private, non-industrial landowners in the North, Inland West, and Alaska may also be viable for such uses as recreation.

**Current condition in each region:** Harvesting on privately owned non-industrial forest lands, especially in the Pacific Coast and Inland West, has recently been economically viable because the curtailing of timber harvest on public lands has increased timber demand and prices. However, the threat of increasing regulations to protect endangered species and other environmental regulations is creating an uncertainty which reduces the attractiveness of investing in forest management in these regions.

Incentives for regeneration (e.g., forest assistance programs) and, in some states, mandates for regenerating harvested land help to make growing future forests a viable option. In contrast, a lack of incentives and infrastructure, as well as estate taxes, often do not encourage long term management of forests. In addition, early weeding, thinning, and longer rotations to ensure high quality and valuable timber has been and is a marginal (or submarginal) economic investment and so is rarely done.

The South and Pacific Coast have the most developed infrastructures of skilled foresters and loggers, primary manufacturing capacity, and markets. The North has what might be called an intermediate infrastructure, although its secondary manufacturing or high value-added infrastructure is developed to a greater extent than perhaps any other region. The Inland West and Alaska have the least developed infrastructure.

Forests in much of the North and Inland West were heavily cut about 80 to 120 years ago. Trees in these forests are again merchantable and providing income for private landowners.

#### **Viability of private, industrial landowners (B-18; C-1, C-2, C-6 through C-11):**

##### **Potential of each region for private, industrial landowners to be viable:**

No region has more than 23 percent of its forest land under ownership of private, industrial landowners. Like forests owned by private non-industrial landowners, these forests are potentially most profitable in areas of high site productivity and close proximity to markets--areas of high population. The South has these factors and 20 percent of its land is owned by private, industrial owners.

The North has moderate site productivity but is close to markets.

The Pacific Coast has the factors of high productivity and proximity to markets (on the west coast of the United States and exports to the Pacific Rim).

The Inland West has low site productivity and is far from markets and so has relatively low viability for industrial landowners.

Alaska is also far from markets and has no private, industrial ownership.

A potentially profitable use of private forest lands is for forest-based recreation. The lack of public lands for hunting in the South makes leases of hunting (recreation) rights of these forests to "hunting clubs" particularly attractive.

**Current condition in each region:** Private industrial forest land ownership in all regions (except Alaska, where there are no private, industrial lands) have recently been very economically viable. Curtailing of timber harvest on

public lands has increased timber demand and prices. Economies of scale are allowing these landowners to accommodate the requirements of environmental regulations such as protecting endangered species. In this respect, industrial lands are more economically viable for timber production than many private, non-industrial lands.

Thinning (except possibly precommercial thinning) and longer rotations to ensure high quality and value timber have generally represented marginal (or submarginal) economic investments and so are rarely conducted.

The South and Pacific Coast have the most developed infrastructures of skilled foresters and loggers, equipment, and markets. The Inland West and North are intermediate in infrastructure.

### **High-volume timber products manufacturers (B-6 through B-10, B-13, B-15, B-16):**

**Potential of each region for high volume timber products manufacturers to be viable:** High volume timber products manufacturers are usually large companies with large capital investments in production facilities (e.g., pulp mills and high technology lumber, plywood, and flakeboard mills). They have historically utilized predominantly conifer species. However, they are increasingly utilizing hardwoods where such species are more readily available and in those cases in which the characteristics of particular species make them useful.

Much of the viability of this industry within each region is related to the region's regulatory environment; however, the continuous availability of raw material is also an important consideration.

Environmental regulations that impact industrial activity in general are increasingly stringent in all regions, though perhaps less restrictive in the South than in other regions. The regulatory environment relative to forests and forest management is most restrictive in those regions dominated by federally-owned forests. The more restrictive environment is reflected in recent, marked reductions in timber harvest in the Pacific Coast, Inland West, and Alaska. In those regions dominated by private ownership of forest lands--the South and North--the regulatory environment is more favorable to active forest management and timber harvest.

The South, North, and Pacific Coast have the highest potential to supply raw material for high volume timber products manufacturers. The South and Pacific Coast can support softwood-using manufacturers because they can produce high volumes of conifers of intermediate quality and because they are close to markets. The North can grow large amounts of timber because it has a large forested area and it is close to markets. Most of the region is more ecologically suited for hardwood growth, and so is better suited for



high-volume hardwood manufacturers than traditional conifer manufacturers. The Inland West and Alaska are far from markets and produce relatively small amounts of products.

**Current condition in each region:** The South is realizing its capacity to manufacture high volume softwood timber products, although there is the potential for higher rates of timber growth than at present. In addition, conifers from all ownerships (public, industrial, and non-industrial private) are being harvest more rapidly than are being grown in much of the South; therefore, the South may be jeopardizing its potential to maintain a viable industry. This region could have a much more viable high volume industry if it utilized more of the small diameter hardwoods.

Although the South is harvesting less than its overall growth (74 percent of its gross growth; 91 percent of its net growth), much of the growth is in hardwoods. Thus, future growth of the southern forest products industry will depend either upon expansion of the hardwood industrial segment or upon conversion of hardwood forests to softwoods. Many of the hardwood forests could equally support conifers (southern pines) which would grow and yield much more volume per acre at the same age--but have different uses.

The North is only moderately realizing its potential to provide high volume products, since only a moderate portion of its growth (40% gross growth and 52% net growth) is harvested. It is also harvesting only a limited portion of its conifer growth (45 percent gross growth and 61 percent of its net growth). This region could have a more viable high volume industry, if it utilized more of the small diameter hardwoods.

The Pacific Coast had, until recently, been realizing its potential to provide high volume products. Recent curtailments of timber harvest on federal lands have reduced, but not eliminated, the viability of this industry. The infrastructure necessary to manage, harvest, and process timber volume from federal lands now in reserves has been reduced. Many of the conifer forests in these reserves will, over time, be lost in stand-replacing wildfires and so will not be available at some time in the future.

Much of the coniferous forests in the Inland West are on federal lands. Only a small proportion of the potential conifer growth in this region is being harvested (31 percent of its gross growth, and 40 percent of its net growth). Even these low levels are declining. The infrastructure of labor, mills, and roads in this region is declining because of recent federal harvest curtailments. Unless stands in the region are thinned or harvested, the probability of catastrophic fires will continue to increase. Over time, much of the federal forests will burn, and so not be available to support a viable forest products industry--or a healthy recreation-based industry or a diversity of habitats--in the future.

Alaska has been harvesting about 50 percent of its gross growth (89 percent of its net growth), and so has provided a moderate amount of timber for high volume timber products. Recent closures of processing facilities have reduced the viability of this industry in the region. Much of the harvested timber in southeastern Alaska could have been used for higher quality products (discussed below).

**Products manufacturers utilizing high quality timber (B-4, B-6 through B-10, B-13, B-15; C-1 through C-9, C-12):**

**Potential of each region for high quality timber products manufacturers to be viable:** Manufacturers of high quality timber products are typically small, independent companies with relatively high employment per volume of production. They are dependent on moderate volumes of high quality wood from selected species, often hardwoods in the North and South and conifers in the western regions. The timber for such high quality products has historically come from relatively old forests or from forests which had been previously thinned. Although some of the products are beginning to be made from young, small diameter, low quality timber in high-volume manufacturing facilities, there is still a large economic segment which utilizes the high quality timber in more labor-intensive manufacturing.

All regions have considerable potential for providing high quality timber and for maintaining a viable economic segment which utilizes it. High quality, high value material can generally be transported farther than low quality, high volume products.

Skilled and non-skilled labor is needed to maintain this industry. The South, North, and Pacific Coast already have relatively large populations which could provide labor forces to manufacture these products. The Inland West and Alaska may need to increase its labor force if the potential for this industry were to become large enough.

**Current condition in each region:** No region is realizing its capacity to provide high quality timber to a very large extent.

Federal lands on the Pacific Coast were providing the high quality timber for these products until National Forest harvesting curtailments began in 1989. The West had only recently begun to develop its secondary, or high value-added, economic segment. Relatively little of the high quality timber remains on non-federal land, and this industry is currently declining in the region. The non-federal forests are being harvested before the trees can reach high quality, and so trees of this type will probably be less available in the future.

The Inland West National Forests were providing moderate amounts of the high quality timber for these products. Much of the harvesting and management of these high quality trees has been curtailed. Management of younger forests has also been reduced, making both younger and older forests extremely susceptible to catastrophic fire. Consequently, the prospects for future forests of high quality trees in the region and the associated industry are not favorable.

The South is providing only moderate amounts of high quality timber to sustain this industry, since much of its growing forests are being harvested when quite young. Additionally, older forests are not thinned sufficiently to become of high quality, even though the predominance of hardwood species are suitable for growing to high quality. There is a moderate, still viable infrastructure of manufacturers of high quality products. The moderate infrastructure of high quality manufacturers are harvesting trees from the small areas of national forests in the region. An impending problem is the loss or reduction of some valuable species (e.g., upland oak species), primarily because of fire control and curtailment of clear cutting on National Forests.

The North has a moderate infrastructure of high quality manufacturers and is providing a moderate amount of high quality timber. Many hardwood forests were heavily harvested about 80 years ago and have only recently developed trees of adequate sizes to be harvested again. Greater amounts of high quality timber are not being grown because the forests are not being thinned and because species of lower quality are growing after past harvesting.

Alaska has not been meeting its potential of providing high quality timber manufacturing very well. Alaskan forests contain a resource of high quality timber, however, only about 50% of its gross growth (89% of its net growth) is being harvested. In addition, much of the timber has been used for pulp production (a high volume timber industry), rather than supporting a high quality infrastructure.

**The recreation industry (B-11, B-20, B-21; C-1, C-2, C-14):**

**Potential of each region to provide a viable recreation industry:** All regions have the accessible recreation areas and at least limited amounts of remote recreation areas. The western regions have more remote recreation areas. The Inland West and Alaska and, to some extent the Pacific Coast, have lower populations; therefore, only those with the time and means to travel there or the few local residents can support the recreation in these areas.

**Current condition in each region:** The current condition parallels the potential in each region.

**Low public costs of managing forest lands (B-2, B-4, B-5, B-11, B-12, B-18; C-1, C-2, C-7 through C10):**

**Potential of each region to manage public lands at a low cost:**

The costs of catastrophic events can include cost of fire fighting, costs of emergency relief and recovery, costs of mitigation procedures, value of lost life and property, costs of reforestation, and costs of environmental damage (e.g., increased stream sedimentation). These costs will be high in the near term in the Inland West, Pacific Coast, and Alaska, since catastrophic fires are increasingly likely in the future. These fires will be predominantly on the large ownership of overcrowded, relatively inaccessible public forests.

Management costs will be less in the South and North than in other regions, because there is an infrastructure of roads, logging equipment, and mills to defer some of the costs by removing the dead or damaged wood and restoring the road system rapidly. The costs will also be low in the South and on private lands (and some federal forests) in the Pacific Coast and Inland West, because past forest management activities have reduced susceptibility to fires, pest epidemics, and other catastrophic events.

The costs of managing federal forests is potentially greatest in the Pacific Coast, where there is proportionally the most federal land area, followed by the Inland West, Alaska, and the North and South, where there is the least federal land. Much of the cost of managing federal land could potentially be offset by the commodity and recreation values provided there. Private forest lands are managed in the North and South for both recreation and timber at a profit. Private forest lands in the Inland West and Pacific Coast are managed for timber production at a profit.

Public and private forests in all regions could generate a net return to governments by treating more intensive forest management for both commodity and non-commodity values as an economic stimulus. Investments by the government in thinning, pruning, and other activities on both public and private lands (through incentives) would immediately generate more employment, wood flow, and economic activity. Analyses have shown that government investments on public and private lands could provide a net return to the government, even though activities promoted by the investment may not be economically feasible for the private landowner without government investment. Incentives could pay the private landowner to provide such public values as biodiversity and greater employment--values for which the private landowner has traditionally received no income (Lippke et al. 1986).

**Current condition in each region:** The cost of active management is a direct concern to the public on publicly owned lands. Approximately 34 percent of the United States' productive forest lands are in public ownership (including reserves). Most of this publicly owned forest land is in the western regions; Inland West (33 percent), Pacific Coast (21 percent), and Alaska (9 percent). The eastern regions (North [23 percent] and South [14 percent]) have less acreage of federal lands, even though they contain 70 percent of the total productive forest area.

About 66 percent of this publicly owned forest land is managed by the U.S. Forest Service. The Forest Service's total annual costs exceed its return from harvest, and therefore is operated at a cost to the public. Much of this extra cost is incurred from expenses connected with research, providing recreation and wildlife conditions, and dealing with inefficient regulations governing Forest Service management, as well as litigation connected with timber sales. Additionally, the costs born by management are often beneficial to non-timber production services (e.g., recreation) or to non-public lands (e.g., research).

The costs of providing fire protection and maintaining road networks to support other values are presently not being well supported by non-timber budgets. As a result, fire protection and road maintenance are increasingly not supported or the costs are being borne by public taxes now that timber harvest is being curtailed on federal forests.

Federal incentives to small, non-industrial private forest landowners, such as providing information and cost-sharing for certain silvicultural activities, have been helpful in providing an economic and environmental stimulus to the landowners and the economy as a whole. Recent, dramatic increases in technology (e.g., G.I.S. and other computer systems) and new information on managing forests for biodiversity have been developed. However, these new developments are not readily available to small, private forest landowners because the incentives programs have not been proportionately expanded.

### **Scenic, existence, and historical values:**

**Potential of each region to provide these values:** All regions have the potential to provide these values, since all have large areas of forests. Some regions may not provide all plants and animals adequately where one or more habitats are in short supply (described earlier). Each region has unique, different scenic qualities. Forest "existence" values, the knowledge that the forest exists, are often more associated with reserves than with actively managed forests. Western regions, therefore, may have more

potential to provide these values. All regions contain historically important areas inside forests.

**Current condition in each region:** The western regions are currently providing the greatest amount of scenic and “existence” values. These regions contain more public land than eastern regions and are managed to promote scenic conditions. The relatively young ages of forests in the South make these forests less aesthetically pleasing (to most people) than forests in other regions. The “historical” values have been provided by establishment of public parks of various types (e.g., “National Historic Sites”) in all regions.

**Spiritual and cultural values:**

**Potential of each region to provide these values:** The eastern regions contain fewer Native Americans with traditional spiritual and cultural ties to forest regions, species, or structures. There are, however, some Native-, European-, and African-American peoples with extended lineages in certain regions which maintain cultural ties to forests. The western United States contains more groups with both cultural ties and contestable legal rights to certain forest areas, species, structures, and resource management and use practices.

**Current condition in each region:** Primarily in the western regions, demands that management accommodate these cultural values is causing management to be altered.